

# Is There an Association Between Study Materials and Scores on the American Board of Orthopaedic Surgeons Part 1 Examination?

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**BACKGROUND:** Previous studies have shown that certain orthopaedic in training examination scores can be used to identify which residents may be at risk for failing the American Board of Orthopaedic Surgeons (ABOS) Part 1 examination. However, no studies have examined how study resources may affect residents' ABOS Part 1 scores. The goal of this study is to determine which review sources or review courses, if any, are associated with improved ABOS Part 1 scores.

**METHODS:** A survey was sent to 221 of the 865 examinees who took the ABOS Part 1 examination in 2012. The questions inquired the respondents how well they performed on previous orthopaedic in training examinations and ABOS Part 1, along with the study sources they most commonly used, review courses they attended, and resources they would recommend if they were to retake ABOS Part 1 examination.

**RESULTS:** Overall, 118 of the 221 (53%) survey recipients completed the survey. Six (5%) of the respondents failed ABOS Part 1 examination. Orthobullets and the American Academy of Orthopaedic Surgeons self assessment examinations were recommended as the primary study source significantly more ( $p < 0.01$ ) than most other resources, but there was no significant association between study source and passing ABOS Part 1 or scoring in a certain percentile on ABOS Part 1. Similarly, there were no associations between attending a review course and either

passing or scoring in a certain percentile for ABOS Part 1. Half of the respondents who failed ABOS Part 1 attended multiple review courses.

**CONCLUSIONS:** There does not appear to be an association between improved ABOS Part 1 scores and orthopaedic study materials or review courses. Further research into the value of certain educational modalities should be conducted to determine the best ways to educate orthopaedic residents and determine the value of some of these commonly used orthopaedic review modalities. (J Surg 71:375-384. Published by Elsevier Inc. on behalf of the Association of Program Directors in Surgery)

**KEY WORDS:** orthopaedic in training examination, American Board of Orthopaedic Surgeons, study resources, orthopaedic review

**COMPETENCIES:** Medical Knowledge, Practice Based Learning and Improvement, Systems Based Practice

## INTRODUCTION

Much like the many studies that have recently been completed regarding the orthopaedic in training examination (OITE),<sup>1-11</sup> many articles have recently examined the associations between certain performance measures and American Board of Orthopaedic Surgeons (ABOS) Part 1 examination scores.<sup>12-18</sup> The ABOS Part 1 examination is the first part of the board certification process for orthopaedic surgeons and is designed to evaluate a candidate's knowledge of general orthopedics and problem solving abilities.<sup>19</sup> It is necessary for orthopaedic residents to pass this exam to become board eligible, and the American College of Graduate Medical Education has mandated that each residency program maintain a pass rate of 75% for first time ABOS Part 1 examinees.<sup>16,18</sup> Considering its importance and that the failure rate for ABOS Part 1 is much higher for those

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residents who failed the examination on their first attempt,<sup>12</sup> it is easy to understand why there is significant interest in selecting residents who are felt to be able to pass this examination<sup>20</sup> and determining which residents are most likely at risk for failing it.<sup>18</sup>

However, previous studies looking at various factors associated with resident performance on ABOS Part 1 pass rates do not appear to offer information on what study resources have been used by residents who pass ABOS Part 1 or what review material those residents would recommend to future examinees. Although the reasoning behind why some residents score better than others on standardized examinations is likely multifactorial,<sup>14,16,18</sup> knowing what, if any, associations exist between resident performance and study material may assist program directors in providing study guidance to their residents for ABOS Part 1. It is not uncommon for residents and residency programs alike to spend thousands of dollars on studying resources or review courses in hopes of being better prepared to pass the ABOS Part 1. However, to the author's knowledge, there have been no previous studies showing that specific studying resources or review courses actually improve a resident's ability to pass the examination. This study was conceived in hopes of determining what associations, if any, exist between ABOS Part 1 performance and study materials used and review courses attended.

## METHODS

### ABOS Part 1 Examination

The ABOS Part 1 examination is administered by the ABOS and is the capstone examination for orthopedic training. This examination is the first of the 2 examinations that an orthopedic trainee must pass to become board certified by the ABOS. Between 2001 and 2012, 77% to 89% of all examinees passed ABOS Part 1 on their first attempt.<sup>21</sup> Without passing Part 1, the candidate is ineligible to sit for Part 2. Most residents sit to take ABOS Part 1 immediately after the completion of their orthopedic residencies. Although there is no limit on the number of times an applicant can sit for Part 1, data suggest that those participants who fail once are at a much higher risk of failing again on repeat examination.<sup>12</sup> The American College of Graduate Medical Education Orthopaedic Surgery Residency Review Committee requires that all accredited programs maintain a first time pass rate of at least 75% for all residents for this examination.

### Examination Preparation

There is no formalized curriculum to prepare for ABOS Part 1. Many residents attend review courses, complete practice questions from previous OITEs or practice examinations, and read review books. In general, most residents

seem to use a combination of all 3 methods as they prepare for the examination. Commonly attended review courses are as follows: Miller's review course, Maine orthopaedic review course, and American Academy of Orthopaedic Surgeons (AAOS) orthopaedic board preparation and review course. Other study materials that are also commonly used include the following: Orthobullets ([www.orthobullets.com](http://www.orthobullets.com)), AAOS comprehensive orthopaedic review (ed, Lieberman JR), AAOS self assessment examinations, AAOS orthopaedic knowledge update 10 (ed, Flynn JM), AAOS orthopaedic (ed, Sarwark J), previous years' OITE questions, and Miller's review of orthopaedics (ed, Miller MD).

### Survey of Examinees

The only organization that has ABOS Part 1 results and contact information for all of the examinees is the ABOS, and such material is their proprietary information. As such, a survey was sent via e mail to 221 of the 865 examinees (26%) of the 2012 ABOS Part 1 examination who participated in the 2012 online Miller/Orthobullets virtual review curriculum. This was a free, online review curriculum developed for ABOS Part 1 review. An e mail was sent to all of the participants in this curriculum offering them inclusion in this study. Although aimed at senior level orthopedic residents, attending surgeons who had previously taken ABOS Part 1 and failed or international graduates who were studying to take ABOS Part 1 could also participate in the Miller/Orthobullets review. Respondents were asked to complete a survey regarding their study habits and examination performance as completely as possible. As can be seen by analyzing the survey ([Appendix A](#)), the questions were meant to delineate how well the respondent performed on previous OITEs and ABOS Part 1, along with the study sources most commonly used, review courses attended, and resources recommended for the ABOS Part 1 examination if they were to repeat the examination. The survey was hosted on [surveymonkey.com](http://surveymonkey.com), and response data were downloaded directly from the website.

### Statistical Analysis

Fisher exact test was used to determine which responses were associated with passing and scoring in higher percentiles for the ABOS Part 1 examination. For question 8, there were 10 study methods listed as tools to determine which variables were ranked the highest as study tools for the examination. There were 3 ways in which study methods were compared with each other. First, it was determined whether or not the study was ranked first, as the primary study method. Second, it was determined if the study tool was ranked first, second, or third (it was at least used somewhat for studying) compared with not ranked at all (the respondent did not use that particular resource for studying). Third, each study method was compared after

assigning them weighted scores calculated by squaring the rank of the particular method. This weighted score used was based on the assumption that a person would be more likely to use their primary recommended resource substantially more than a source they recommend as the third choice. If the method was ranked first, it received a weighted score of 1. If it was ranked second, it received a weighted score of 4. If it was ranked third, it received a weighted score of 9, and if it was not ranked at all, it received a weighted score of 16. The means of the weighted scores were compared using Student *t* test with a Dunnett correction.

## RESULTS

Overall, 118 (53%) of the 221 survey recipients completed the survey. Six (5%) respondents reported failing ABOS Part 1. The percentiles reported for each respondents' ABOS Part 1 and OITE can be seen in [Table 1](#). No more than 10% of the respondents scored above the 90th percentile on either of the postgraduate year (PGY) OITEs or ABOS Part 1. The median percentile range for each OITE was slightly higher than the median percentile for ABOS Part 1. No respondent who scored above the 70th percentile on their PGY 4 or PGY 5 OITE failed ABOS Part 1.

An analysis of the OITE scores for those respondents who passed and those who failed ABOS Part 1 can be seen in [Figure 1](#). There was no significant association between percentile scores for PGY 3 ( $p = 0.1443$ ), PGY 4 ( $p = 0.7866$ ), or PGY 5 ( $p = 0.0762$ ) OITE scores and passing ABOS Part 1. However, as [Figure 2](#) demonstrates, respondents who failed were significantly ( $p = 0.0475$ ) more likely to score in the 25th percentile or lower during their PGY 5 OITE than those who passed (3/6 [50%] vs 19/110 [17%], respectively). The overall relationship between OITE percentile scores and ABOS Part 1 percentile scores can be better appreciated in [Figure 3](#). For all PGYs, there was a significant (PGY 3,  $p < 0.0001$ ; PGY 4,  $p = 0.0169$ ; and PGY 5,  $p = 0.005$ ) association between a respondent's score on the OITE and their ABOS Part 1 percentile scores. Respondents tended to score in the same percentile range on ABOS Part 1 as they had scored on the OITE.

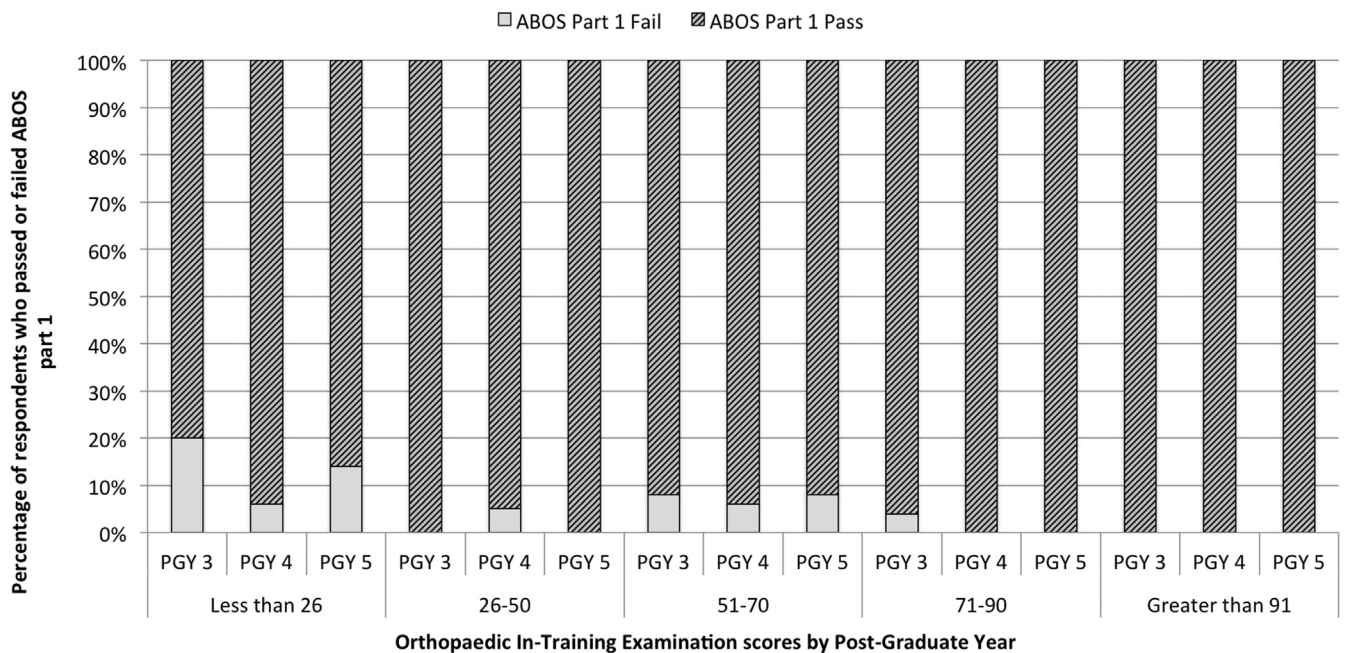
The primary study sources the respondents used for ABOS Part 1 can be seen in [Table 2](#). The AAOS

self assessment examinations (38/116, 32%) and Orthobullets (37/116, 32%) were listed as the primary study source of the respondents significantly ( $p < 0.01$ ) more than all other resources except for Miller's review of orthopaedics (28/116, 24%). In fact, the AAOS self assessment examinations, Orthobullets, and Miller's review of orthopaedics were chosen as the primary study source more than 4 times as often as all other resources. Still, there was no association found between using a specific primary study source and scoring in a particular percentile or passing ABOS Part 1 ( $p = 0.0509$  and  $p = 0.2314$ , respectively) ([Fig. 4](#)). However, 5 of the 10 respondents who scored above the 90th percentile on ABOS Part 1 indicated that their primary study source were the AAOS self assessment examinations. When ranking which study resources the respondents would use if they were to take ABOS Part 1 again, more participants indicated that they would use the AAOS self assessment examinations as their primary resource (41/116, 35%) than any other source. The only other resources that at least 10 of the respondents stated they would use as their primary study source if they were to retake ABOS Part 1 were Orthobullets (31/116, 27%), Miller's review of orthopaedics (19/116, 16%), and content from the Miller's orthopaedic review course (11/116, 9%). Orthobullets was ranked as the primary, secondary, or tertiary study source significantly more often (86/116, 75%;  $p = 0.0346$ ) than all other resources, and the mean weighted score of each study source recommended by the respondents can be seen in [Figure 5](#). This figure demonstrates that when looking at all of the recommendations from respondents as to if they would use a particular resource as a primary, secondary, or tertiary study source if they were to take ABOS Part 1 again, Orthobullets and the AAOS self assessment examinations were given higher recommendations than all other study materials.

Only 8% (9/116) of respondents stated that they did not attend a review course before taking ABOS Part 1, and 18% (21/116) of all respondents stated that they went to more than 1 review course. Half of the respondents who failed went to more than 1 review course, whereas none of the respondents who did not go to a review course failed ([Table 3](#)). There were no significant differences found between passing and failing regarding which review courses were attended except for the Maine orthopaedic review course. Half of the respondents who failed (3/6) attended

**TABLE 1.** The Number of Respondents Who Scored Within Each Percentile Range (Percentages in Parentheses)

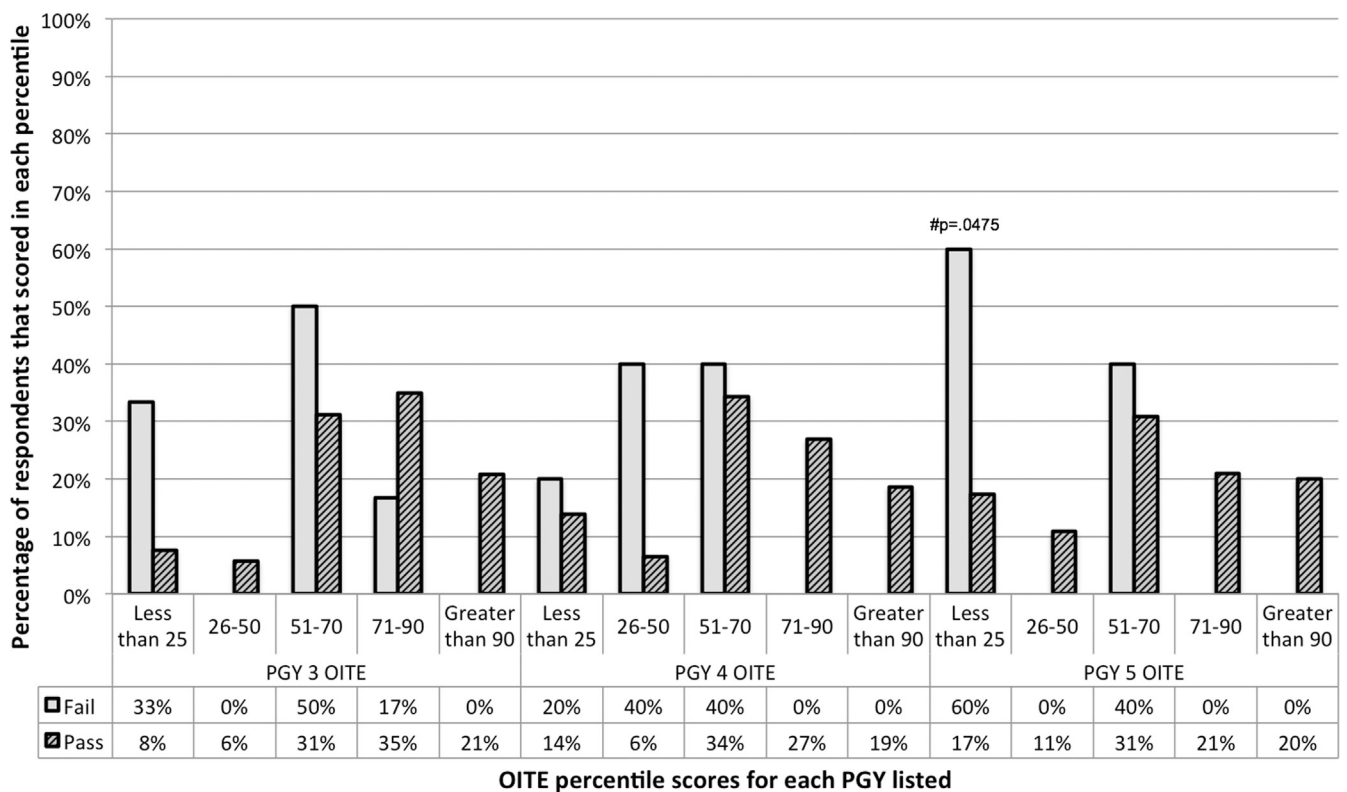
Percentile Scored	PGY 3 OITE		PGY 4 OITE		PGY 5 OITE		ABOS Part 1	
Less than 26	10	9%	16	14%	22	19%	25	21%
26-50	33	29%	39	35%	34	30%	35	30%
51-70	40	36%	31	27%	25	22%	28	24%
71-90	23	21%	20	18%	22	19%	20	17%
Greater than 90	6	5%	7	6%	12	10%	10	8%
Median percentile	51-70		51-70		51-70		26-50	
Total respondents	112		113		118		118	



**FIGURE 1.** Graph showing the percentage of respondents who passed or failed the ABOS Part 1 examination and what their percentile scores were on the PGY 3, 4, and 5 OITEs.

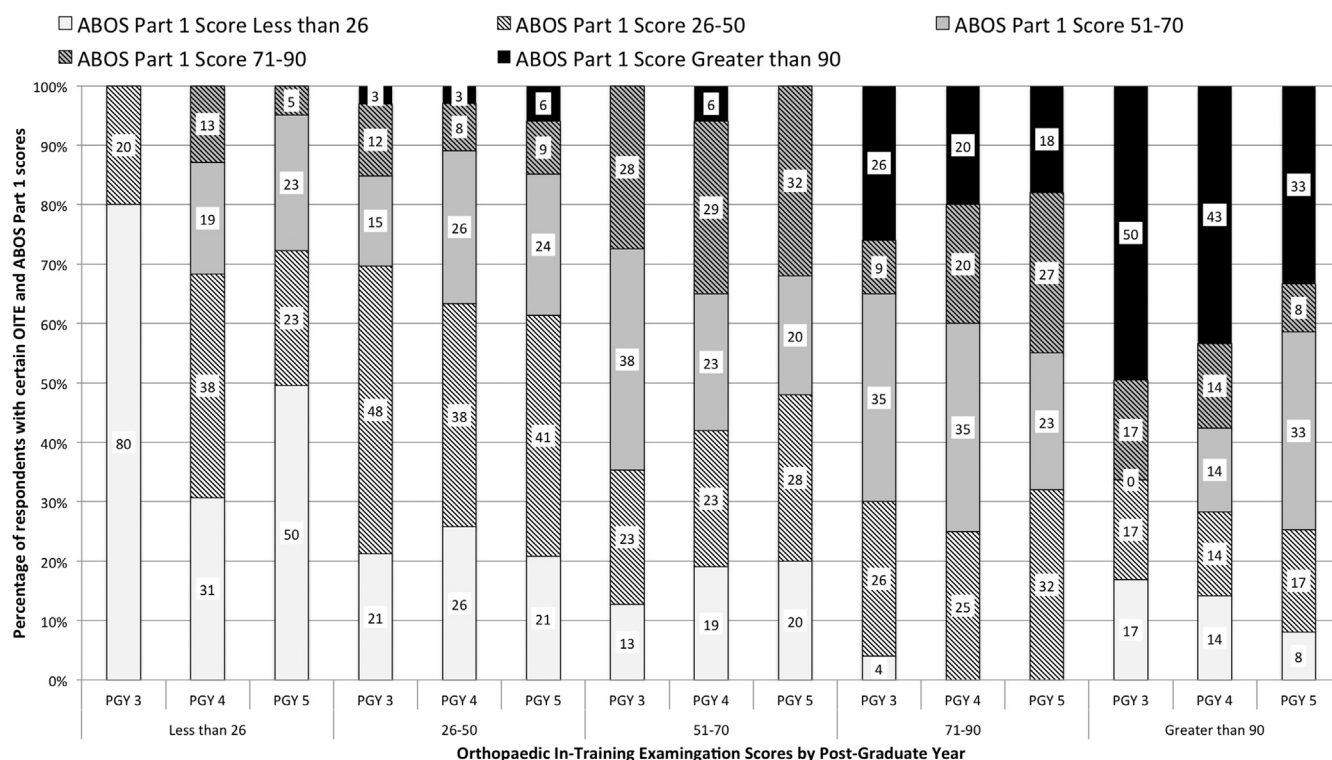
that course, whereas only 10% (11/110) of the respondents who passed the examination attended that course ( $p = 0.0030$ ). However, it should be noted that all of the

respondents who went to the Maine orthopaedic review course and subsequently failed also went to at least 1 other review course. [Figure 6](#) shows that there was little difference



**FIGURE 2.** Graph showing the percentage of respondents who scored in each specified percentile range on the ABOS Part 1 examination and what their percentile scores were on the PGY 3, 4, and 5 OITEs. #: significant difference between those who passed and failed ABOS Part 1.





**FIGURE 3.** Graph showing the percentage of respondents who ended up scoring within a specific percentile range on the ABOS Part 1 examination after scoring a specific percentile on their PGY 3, 4, and 5 OITEs.

in percentile scores for both OITE and the ABOS Part 1 scores between those respondents who attended multiple review courses and those who did not go to a review course. When looking at the PGY 4 and PGY 5 OITE percentile scores, it was found that 40% (4/10) of respondents who did not go to a review course stated that their PGY 4 and PGY 5 OITE scores were in the 25th percentile or lower compared with 5% (1/21) and 20% (4/21) of those who went to multiple review courses, respectively.

## DISCUSSION

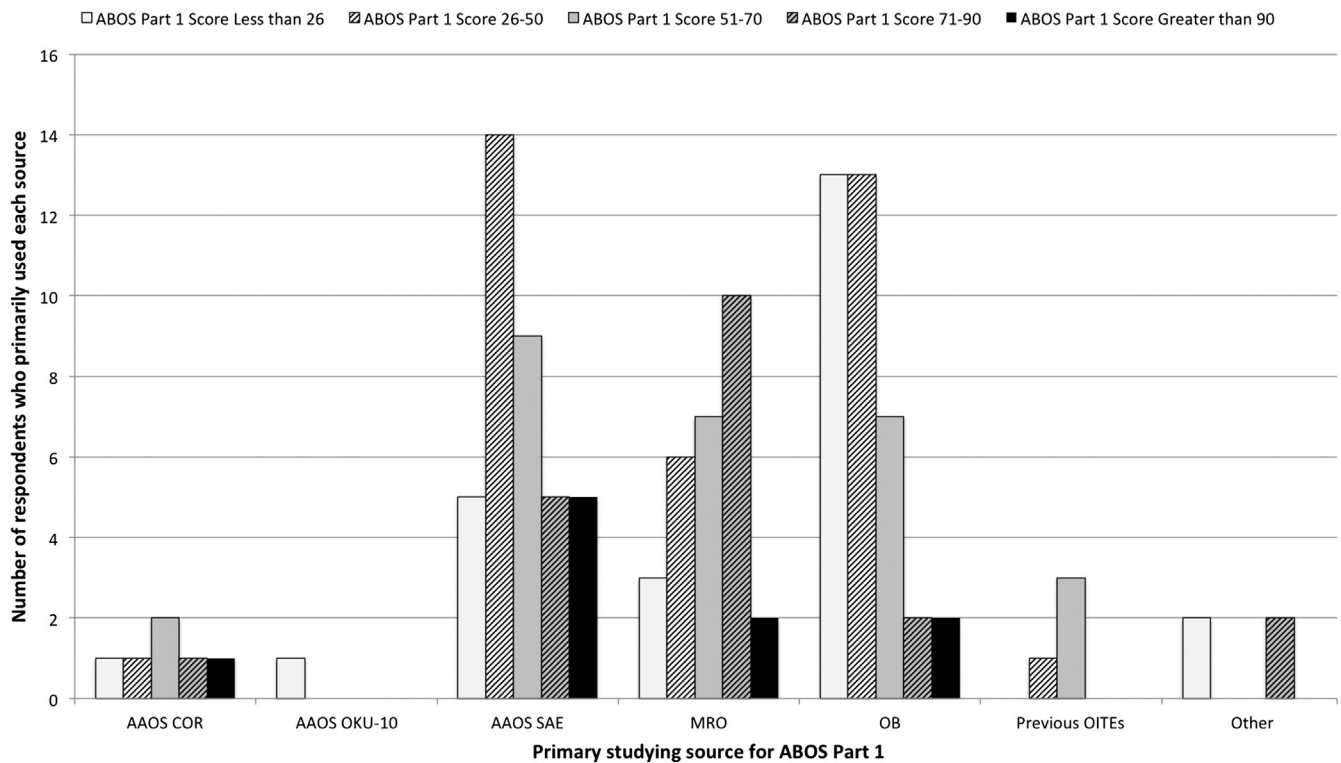
Passing the ABOS Part 1 examination is necessary to become a board certified orthopedic surgeon. Although the overall pass rate for ABOS Part 1 improved from 79% in 2011 to

85% in 2012, a 15% failure rate means that 130 of the 865 trainees who sat for the examination in 2012 failed. Learning what studying materials or review courses may improve a candidate's ability to score well on ABOS Part 1, if any, could be extremely valuable in helping residents improve their chances of passing the examination.

The respondents in this study had a lower failure rate (5%) than the overall failure rate for all takers of ABOS Part 1 in 2012 but had a failure rate that was very close to that of first time US and Canadian test takers (6%). Although the low number of failures made it difficult to determine significance regarding passing or failing ABOS Part 1, this study clearly demonstrates that improved percentile scores on PGY 3, 4, and 5 OITE examinations are associated with improved percentile scores on ABOS Part 1. This finding is in line with numerous other studies that have shown an association or a correlation between these scores<sup>12,15,17,18,22</sup> and is also the first to show such associations when looking at residents who took both the OITE and the ABOS Part 1 using computerized examinations.<sup>15,18</sup> More importantly, these findings help demonstrate that the responses used in this study came from examinees who were relatively diverse in terms of scoring on both the OITE and ABOS Part 1. This variety of high and low scores on the OITE and ABOS Part 1 is likely to be present in many residencies, helping increase the external validity of this study's results.

**TABLE 2.** The Number of Respondents Who Listed Each Resource as Their Primary Studying Source For ABOS Part 1

Primary Study Source for ABOS Part 1		
AAOS self-assessment exam questions	38	32%
Orthobullets website	37	31%
Miller's review of orthopaedics textbook	28	24%
AAOS comprehensive orthopaedic review	6	5%
Previous years' OITE questions	4	3%
Other	4	3%
AAOS orthopaedic knowledge update	1	1%

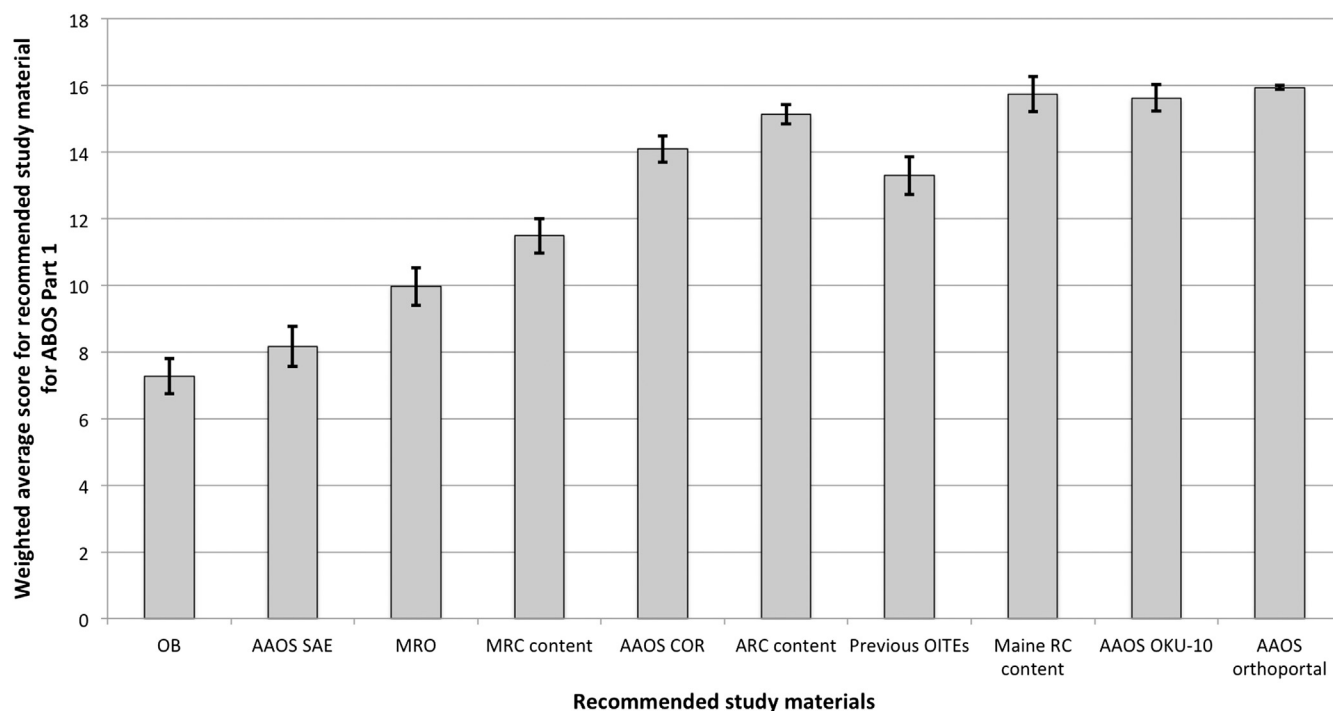


**FIGURE 4.** Graph showing the percentage of respondents who scored within a specific percentile range on the ABOS Part 1 examination and what their primary study source was during examination preparation. AAOS COR, American Academy of Orthopaedic Surgeons comprehensive orthopaedic review; AAOS OKU-10, American Academy of Orthopaedic Surgeons orthopaedic knowledge update 10; AAOS SAE, American Academy of Orthopaedic Surgeons self-assessment examinations; MRO, Miller's review of orthopaedics; OB, [www.orthobullets.com](http://www.orthobullets.com).

This study found no associations between using a specific study source and either scoring within a particular percentile or passing ABOS Part 1. Still, there were some general patterns that are worth mentioning. First, respondents used the AAOS self assessment examinations and Orthobullets as their primary studying source significantly more than any other source except for Miller's review of orthopaedics. Using previous OITE questions has been previously determined to correlate with improved OITE scores,<sup>23</sup> and this study shows that using question based sources seems to be the preferred method of review for this cohort. It seems likely that trainees would like to try to maximize their exposure to questions before taking ABOS Part 1 for a couple of reasons. First, it helps to prepare the examinee for the format of the examination. Second, it appears that some orthopedic topics are either deemed more important to understand or easier to test than others. Practice questions, regardless of source, seem to be more likely to expose examinees to these topics during their studying than studying formats. Lastly, it is important to note that this cohort of responders was derived from an online review course run by a company (Orthobullets) that is largely popular because of the questions it provides to its users. Therefore, this cohort may be more likely to favor questions over other forms of review materials (i.e., books) based on sampling bias alone. Still, it is worth noting that the respondents of

this study, of which 94% passed, stated that they would recommend using the question based AAOS self assessment examinations and Orthobullets more than any other resource if they were to prepare for ABOS Part 1 again. Such a finding seems to indicate that these respondents felt that these 2 studying resources prepared them well for the examination.

The findings of this study in terms of ABOS Part 1 performance and participation in an orthopedic review course are interesting. Overall, there were no associations found between scoring in a particular percentile or passing ABOS Part 1 and attending a specific review course except for the Maine orthopaedic review course. Although the respondents who failed were significantly more likely to go to the Maine orthopaedic review course, it should be highlighted that those respondents who went to that review course and failed went to at least one other review course as well. When looking at the respondents who represented the extremes of review course attendance (those who did not go to a review course and those who went to more than 1), it is noted that there were very little difference between their ABOS Part 1 percentiles. These findings may reflect more about the participants attending (or not attending) a particular course than the courses themselves, as those who attended a course may have felt that they were not as prepared for the ABOS Part 1 from their residency, had



**FIGURE 5.** Graph showing the weighted, mean rank of each review source listed. OB, [www.orthobullets.com](http://www.orthobullets.com); AAOS SAE, American Academy of Orthopaedic Surgeons self-assessment examinations; MRO, Miller's review of orthopaedics; MRC Content, content obtained from Miller's review course; AAOS COR, American Academy of Orthopaedic Surgeons comprehensive orthopaedic review; ARC content, content obtained from the American Academy of Orthopaedic Surgeons orthopaedic board preparation and review course; Maine RC content, content obtained from the Maine orthopaedic review course; AAOS OKU-10, American Academy of Orthopaedic Surgeons orthopaedic knowledge update- 10; AAOS orthoportal, <http://orthoportal.aaos.org/>.

more anxiety about the examination, or studied less independently because they attended at least 1 review course than those who chose not to attend such a course. However, it is worth noting that 40% of the respondents

**TABLE 3.** The Number of Respondents Who Went to Each Listed Review Course or Combination of Review Courses and Those Review Courses That Those Respondents Who Failed ABOS Part 1 Attended.

Review Course	Participants	Failed (%)	
AAOS only	10	0	0
MRC only	73	3	4
Maine only	2	0	0
None	10	0	0
Review course not listed	1	0	0
AAOS and MRC	9	0	0
AAOS and Maine	3	1	33
MRC and Maine	7	1	14
All 3 courses	2	1	50

MRC, Miller's review course; Maine, Maine orthopaedic review course.

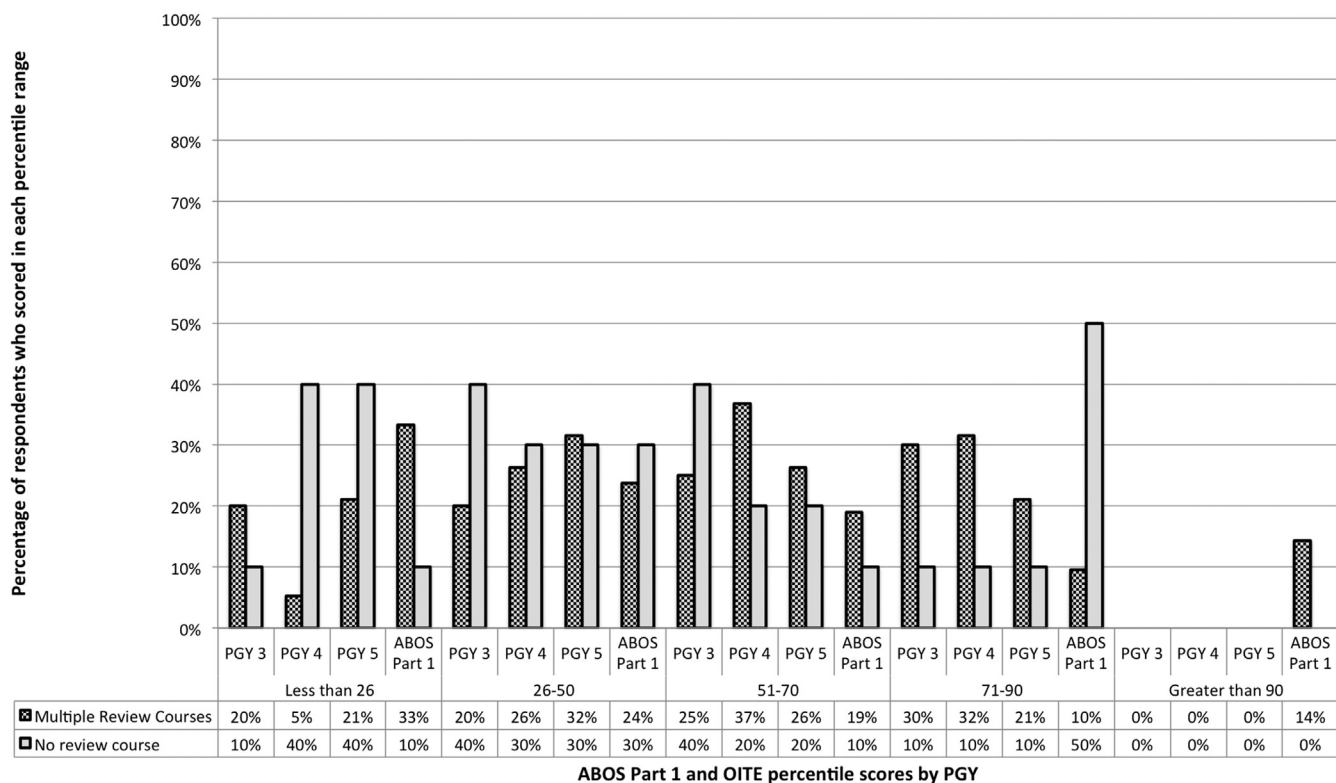
Of 6, 3 (50%) respondents who failed went to multiple review courses.  
Of 10, 2 (20%) respondents who scored above 90th percentile on ABOS Part 1 went to multiple courses.

Of 25, 7 (28%) respondents who scored less than 25th percentile on ABOS Part 1 went to multiple review courses.

who stated they did not attend a review course scored in the 25th percentile or lower during their PGY 4 and PGY 5 OITEs compared with 5% and 20% of those who attended multiple review courses, respectively. Such a finding would seem to suggest that those the 40% of respondents who did not attend a review course and scored below the 25th percentile on their PGY 5 OITE would be more concerned about their potential for failing ABOS Part 1 than 5 and 20% of respondents who attended multiple courses and scored below the 25th percentile on their PGY 4 and PGY 5 OITEs, respectively. This would seem especially true considering that the largest previous study looking at correlations between OITE and ABOS Part 1 scores found that the correlation between OITE score and ABOS Part 1 result increased with resident matriculation and that probability of passing ABOS Part 1 was only below 90% for those residents who scored below the 20th percentile on their PGY 4 and PGY 5 OITEs.<sup>8</sup> Still, with such a low number of responses from members of both groups, these data remain fragile and should not be used to draw strong conclusions regarding the value or effectiveness of review courses.

This study is not without limitations. Despite its relatively large size in comparison with previous studies on this topic, only 14% of all examinees for ABOS Part 1 in 2012 participated in this survey. Respondents who typically do





**FIGURE 6.** Graph showing the specified percentiles the respondents scored on PGY 3, 4, and 5 OITEs and ABOS Part 1 if they had gone to multiple review courses or no review courses.

well or have enjoyed the subject being discussed commonly bias surveys by responding at a greater rate than those who have had a negative experience. This may explain why the pass rate for our respondents was higher than what would be expected based on the data regarding pass rates obtained from the ABOS. However, our pass rate was very similar to that of first time US and Canadian test takers. This is likely because any international graduate sitting for ABOS Part 1 would not have taken the OITE and would be unable to fully participate in the survey. Additionally, only those people who completed the 2012 Miller/Orthobullets virtual review curriculum received a survey, making this a convenience sample. This limitation therefore means the respondents may not adequately represent the general population of test takers and may decrease the external validity of this study. However, this limitation also means that this cohort represents a group of examinees who are taking both the OITE and ABOS Part 1 in a computerized format. Such a cohort has not been evaluated by previous studies looking at OITE and ABOS Part 1 correlations,<sup>15,18</sup> and it is likely that the role of online review courses and materials would only increase in the future. Furthermore, the survey was not limited to first time test takers or to US and Canadian candidates. It is unknown how many of the respondents had previously taken ABOS Part 1 and failed. If all 6 of the respondents from the

survey had already failed once before, this could dramatically affect the external validity of these results. However, the distribution of this survey certainly provided us with a wide variety of residents from multiple programs unlike previous studies,<sup>12,15</sup> and it appears that only the ABOS themselves would have the ability to gather similar data on a larger group of examinees. Surveys are also based on recall and self reporting, both of which carry their own inherent biases. There was no way for the authors to validate the respondents' scores, as such information is proprietary information of the ABOS. Lastly, we do not know how many of these respondents had taken the examination before and how many were taking it for the first time. It may be that repeat test takers have much different study habits than first time test takers.

## CONCLUSION

Considering the devotion to evidence based medicine principles, it seems intuitive that similar practices should be sought for orthopedic education. Despite the limitations mentioned, this study appears to be the first to evaluate the effect of both specific study materials and review courses on ABOS Part 1 performance. Although there were no significant associations found between specific studying

materials or review courses and passing or scoring in certain percentiles in the ABOS Part 1 examination, this study seems to indicate that question based review sources are preferred over books. However, considering the limited sample size and limitations mentioned within this article, it is impossible to say that no such relationship exist. Until further studies can be completed to further address what studying materials, if any, are correlated with improved ABOS Part 1 scores or pass rates, residency directors and residents alike should continue to use whatever study resources they feel they learn best from. The results of this study should be used to further guide prospective studies that examine the value of certain studying resources and not as definitive evidence stating which resource are or are not valuable.

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## SUPPLEMENTARY DATA

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.jsurg.2013.11.005>.]